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EDITORIAL NOTES

B.G.F. AND B.G.A.

ELSEWHERE in this issue we give the news of Sir David Milne-Watson's retirement from the chairmanship of the Council of the British Gas Federation—that child of his brain which was born with such an apparently brilliant future but which, for reasons we have never been able to fathom, failed ever to reach full maturity. The Gas Industry owes him a debt of gratitude for this—by no means his first—attempt to guide it to a unified front and, even if the Federation was only a shadow of what it might have been, it did at least provide an organization in name which was able to answer the insistent demand for a planning report.

Dr. E. V. Evans nobly steps into the breach as captain of the sinking ship, as sink it surely must when the British Gas Association is finally launched—an event which Sir David declared in his parting speech to be imminent. There must be a captain who traditionally will be the last to leave the bridge, but the Industry has need of Dr. Evans, and will trust that he will not go down with the ship. Indeed, there are doubtless excellent constitutional reasons for this last moment appointment, and since "constitutions" have loomed so large at Gas Industry headquarters for so long, it would be churlish to quibble at them at this stage. As we have remarked on several occasions recently, we hope the new organization will enable more attention to be paid to matters of more general interest to the nation, otherwise our prospects as an Industry are poor.

Sir David's forecast that the British Gas Association will shortly come into being gives us a peep, albeit a tantalizingly fleeting one, behind a veil which has been close drawn ever since the Planning Report appeared. The fact, however, that we of the Press have been discouraged from passing on any authentic news of progress in the negotiations has not eliminated speculation among what is usually called the rank-and-file of the Industry, and wherever two or three gas men are gathered together it has for some time been a lively topic of discussion. More recently such private debates have tended more and more to concentrate upon the very interesting matter of the Director who is contemplated in the Planning Report as the hub of the whole works. The most intriguing guesses are rife as to whether the appointment will be made within the Industry, or whether an attempt is to be made to attract an outsider. There is, of course, the third possibility as it were of a compromise, since quite a number of men are holding eminent positions in the Gas Industry and have detailed knowledge of its working, and yet are not so deep-dyed in its traditions as to be deemed ultra-conservative about it.

We assume, in the first place, that not a moment's thought would be given to a merely decorative figure-head. There is far too much serious work on hand to justify indulgence in any such luxury, and the apparent shape of things to come should, we think, warn us against any such choice. We must decidedly have a man who will be generally acceptable in outside contacts, which will be many, and in reconciling internal divergencies of view, which also are unlikely to be few. But we will not attempt to compile a list of the necessary qualifications; others may enjoy doing so, as well as imagining that they have the unlimited (within reason) salary to offer which the Gas Industry must clearly contemplate offering for the right man. The *pros* and *cons* of looking for him within or outside the Industry are easier to summarize. To select the big chief from without would be the more speculative course, and it certainly would not become immediately apparent whether or not he was likely to make a success of it. As a gesture of determined reconstruction, it would probably have greater prestige value than the appointment of anybody from the Industry's own ranks, and yet might be read as something of a confession of failure. One point, however, which must enter into consideration is to what extent quick results are vital, and how far these could be expected from a man who still had his Gas Industry to learn as compared with one who knows it already.

These are merely interesting speculations—trends of thought, that is to say, which are interesting a great many people in the Industry to-day. We are *not* candidates for a seat on the selection board.

RATIONAL THINKING

IT is very interesting to consider the benefits which the nation would gain by the greater development of the Gas Industry and the substitution of its smokeless fuels in place of raw coal. There are very many angles to the question, which is essentially a national one, and there is little doubt that the development of the Industry will depend on the extent to which the Government, civic authorities, and the public generally are convinced of these benefits. This may seem platitudinous, but we think that ignorance of the possibilities of smokeless fuels and the processing of coal for its chemical products generally prevails. Were it not for this indifference to the need for using coal in the best way, there would be an insistent call for co-operation among the fuel industries, including electricity—to the advantage of the individual and the nation. And we say this in no propaganda sense for gas. Whether or not there will be a measure of co-operation between gas and electricity after the war we do not know, but we are firm in our belief that with some form of co-operation both industries could expand together, and the consumer would get his gas and his electricity at lower cost than would be possible under conditions of blind competition. There is, for example, the problem of load factor, and it is a very real problem for the electrical industry. There has, of course, been much discussion on this matter in electrical circles, and it has been stated quite frankly that the electric cooking load is attractive only so long as the system peak occurs in the late afternoon—a condition becoming a thing of the past in this country. The non-feasibility of undertakings supplying a developed domestic load at a tariff incorporating a running charge of a halfpenny a unit without incurring financial loss has been pointed out; yet a running charge of a halfpenny a unit would appear to be a maximum to allow of any extensive use of electricity. Again, in electrical circles it has been suggested that had it not been for the war the electric fires which might have been connected to the lines would have resulted in a state of affairs beyond control. And much thought has been given to restrictive electricity supply—a supply which the domestic consumer can have only at times defined by the supply undertaking. Considerations such as these make us hope for some co-operation. Should our hope prove vain, the Gas Industry, we well know, will resume the competitive battle with no little vigour.

What brought these thoughts to mind was a Paper given last Thursday to the Institute of Fuel, jointly with all the Chemical Societies, by Mr. G. M. Gill and Mr. John Roberts. An abstract appears on later pages of our issue to-day. A major note of the Paper was that by processing coal we create employment. That we find it difficult to follow the particular deductions set out by the Authors does not really matter very much; we agree with their argument in principle. It seems obvious enough to us that many more men can be employed, and usefully

employed, in treating coal scientifically and efficiently than can be employed in raising the coal and transporting it to a point of combustion in domestic premises. What extra labour follows the burning of raw coal in the domestic hearth devolves upon the housewife, who is not paid for it, and surely does not desire it. Perhaps we ought to add that a certain amount of employment is given to chimney-sweeps, dustmen, and so on, but such employment is not productive. What we need is productive employment. The argument, for example, that more painters are employed because the atmosphere of our towns is full of smoke is wholly specious. The point is that, by and large, coal processing does create productive employment, and should be a national policy after the war. Electricity generation does not, of course, fall into the same category as domestic consumption of raw coal; the electricity produced is creative of vast useful employment, and the same applies to coal carbonization or gasification, for some of the products form the starting-point of chemical industry, and here the field is charged with potential. Domestic burning of raw coal is a basic source of waste. To our mind, a working understanding of some sort between gas and electricity is the best way of tackling the elimination of this waste. If nothing can be done about this, then, as we have said, gas will enter the competitive lists gaily and cheerfully after the war and can do so in full confidence.

We have spoken of the potentialities of coal processing, and here we should like to refer to a specific point mentioned by Mr. Gill and Mr. Roberts in their Paper. Millions of tons of soot are discharged into the atmosphere every year, where its presence is most unwelcome. The carbon of soot, however, is an ingredient essential to industry in peace and in war. The Authors pointed to the fact that soot has been deliberately manufactured from natural gas in other countries for a number of years, the product of manufacture being "carbon black," now so greatly needed for reinforcement in the manufacture of rubber. The imported product makes demands on shipping space. Can the Gas Industry help, even though tons of soot are being poured into the air from domestic grates? They suggested one answer to the question—the gasification of surplus tar with the recovery of carbon black as a by-product, and they explained that work in this direction is being carried out on a considerable scale in four gas-works at the present time. Actually we have been in close touch with this work, but the time is hardly ripe for useful comment or description. We would, however, call attention to the Authors' contention that, although results have not yet reached the 100% efficiency stage, the process concerned (the Jones tar gas process) will "certainly be one solution of the problem of producing carbon black from home-produced coal," and "this departure definitely promises to be of outstanding importance."

SMOKE

THE importance of the subject fully warrants our repeated references to the smoke problem, and in particular to the work of the Smoke Abatement Society—work which has been marked more by enthusiasm than affluence. The Gas Industry and many gas undertakings have, of course, continuously supported its activities, but when all is said and done the Society's high-peak income just before the war was only the modest sum of £1,200 a year—wholly inadequate for a campaign sufficiently large or intensive to kindle public opinion, absurdly inadequate when one considers that out of this sum the Society has to be kept in being. Basic expenses paid, there has been very little left for propaganda purposes, and it has always surprised us what a good showing has been made in the circumstances. We return to the matter here in view of a very frank analysis of the Society's financial position published in the current issue of its Journal, *Smokeless Air*, a copy of which we have just received. This analysis, by the way, is not in the nature of a prelude to an official plan; it is not an official appeal for money, but it does make one think. How can "campaigns" be undertaken on, say, a couple of hundred pounds a year? That, in a nutshell, is the position. To conduct any campaign directed towards creating mass public opinion needs at least £50,000 a year, or possibly twice that amount to be speedily effective. It seems to us highly improbable that the Society will ever enjoy an annual income of anything like £100,000 a year, but surely it should be possible to augment its present income, which is of the order of only £1,000, and to concentrate effort in the direction of what may be termed "informed opinion"—teachers and politicians, doctors and architects, women's organizations, and youth and education movements, and so on. And we feel sure that a great deal could be achieved with an income of the order of £10,000.

We have no doubt that in work of this nature an increasing income would be likely to increase at an accelerating pace, and the first step, of course, is to reverse the present ratio between creative expenditure and basic costs. And in this regard we are interested in a suggestion put forward in the analysis to which we have referred. It relates to the giving of an impetus to the Society's work, and queries whether members who could afford to do so would increase their subscriptions for a limited period. In brief, ten thousand a year for three years, for example, would take smoke abatement much farther along the path of success than would a thousand for thirty years. And if ten thousand is over-optimistic and wide of possibility, at least the germ of the idea appears to us to be sound enough, and we think that if the Society's financial position as it stands to-day was more widely known and appreciated, the ratio of which we have spoken would be reversed. Perhaps the plain statement of affairs set out in *Smokeless Air* will have some practical effect post-war.

This Year's Institution Meeting

The Annual Meeting of The Institution of Gas Engineers will be held next June in Edinburgh under the Presidency of Mr. James Jamieson, Engineer and Manager of the Edinburgh Gas Department. This interesting item of information is contained in our reports on a later page of the recent meeting of the Central Executive Board of the N.G.C. and of the Council of the I.G.E. During the past twenty years very few Institution meetings have had their venue other than London—Cardiff in 1928, Leeds in 1930, and Liverpool in 1933.

The "Big Push"

We note with interest the decision of the British Electrical Development Association to fix this year's subscription at the full normal rate. The Association intends to be ready for what it conceives will be a "big push" as soon as the war ends. Actually, half the amount is being asked for at the moment for current expenditure. The other half will be a reserve to be called upon when the time comes—and the money will be there. We gather that electricity supply undertakings are very pleased with this move, which is calculated to enable them to be "quick off the mark" on the return of peace—or ought we to say, in spite of our comments on the desirability of sane co-operation between the fuel industries in the post-war era, the return of competitive war.

Personal

Mr. J. C. WILLIAMS, Secretary of the Wrexham Gas Company, has just completed 50 years' service, having commenced as a Junior Clerk in January, 1894, and risen to his present position, a post he has occupied for the past 23 years. At the meeting of the Board of Directors held on Jan. 7 the following resolution was passed: "To place on record the Directors' appreciation of Mr. Williams' loyal and devoted service, and to extend to him their warmest congratulations and best wishes for his future health and happiness."

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The Stalybridge Gas-Works Committee has appointed Mr. JOHN BAXTER FLEMING to be Deputy Engineer and Manager of the Gas Undertaking, and he will take up his duties on March 1. Mr. Fleming was educated at Dumbarton Academy and Glasgow University. He received his training with the Glasgow Gas Undertaking at the Dawsholme and Dalmarnoch Works, being Engineering Assistant at the latter for two years, and in his present appointment with the Halifax Gas Department he has been Chief Engineering Assistant for two years.

Mr. R. E. JONES, B.Sc., has been awarded the Institution Gas Research Fellowship in succession to Dr. J. E. GARSIDE, who has been appointed Assistant Lecturer in Fuel Technology at Leeds University.

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Mr. J. WATT, Foreman Brassfinisher for Messrs. Sawer & Purves, completed fifty years' service on Jan. 3, and to mark the occasion the Chairman, Mr. J. Morley, presented him with a cheque in appreciation of his service. Mr. Watt enjoys good health and is continuing in the service of the Company.

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Corporal B. PLUME, Secretary to the Editor, and editorial assistant on the "JOURNAL" staff, who joined the W.A.A.F. in 1942, is Mentioned in Despatches in a supplement to the *London Gazette* dated January 14.

Obituary

The death occurred on Dec. 26 of Mr. A. J. PITT, at the age of 67 representative of Falk, Stadelmann & Company, Ltd. During the whole of his service, from January, 1908, until his retirement in June, 1943, he acted as representative, first in town and country, attached to the Head Office in London, and later attached to the Manchester Branch.

* * *

Mr. A. E. FROST, reinforced concrete engineer and contractor, died at his home at Cannon Hill, Southgate, on Dec. 17. He was known to many gas engineers in the south of England, for whose undertakings he had carried out constructional work.

Letters to the Editor

Gas Boards

DEAR SIR,—I have read the letter by Mr. Currier, of Bradford, in your current issue, with interest without being very impressed. He implies that unless the Gas Industry comes under bureaucratic control (for whatever specious title is used, that is what it means), and is bolstered up by the Government, its future is doomed. If the Industry is in such a sad condition as that, then the sooner it closes down the better, but I can see no reason for taking that view.

It may be desirable for corporation-owned undertakings in the North to be grouped together under a joint Board, but that does not provide any good reason why the entire Industry should be forced into a scheme of nationalization, whatever title it may be given.

Grouping of gas companies under keen and progressive managements is taking place to the advantage of the Industry and public alike, and it is difficult to see how public ownership is going to improve it. Surely compulsory elimination of competition is not going to benefit the Public.

Mr. Currier appears to be charmed with the claptrap about private unenterprise and the glorious visions conjured up by public ownership. I have had some experience of the latter, and failed to observe the perfection which we are asked to believe it possesses. Nor can I agree that gas company management on the whole has been grossly inefficient.

It would be well for those who listen so eagerly to the demands put forward by a group of demagogues for the abolition of private enterprise, to pause and realize that it would also involve the sacrifice of private liberty—liberty to dispose of our labour and our goods as we will.

I take no pessimistic view of the Gas Industry's future, although I consider there is room for more enterprise. As an instance, too little interest is taken in gas appliances after they are fixed. There should be a full and regular servicing of apparatus. We sell material for cleaning gas cookers, and talk of the dirty condition of Mrs. Jones's cooker. If any manager has not tried cleaning a cooker I would recommend him to make the experiment. It should not be beyond the wit of man to devise an electrically operated device with cleaning and buffing brushes with which the service men could clean the cooker *in situ*. Similarly all other apparatus should be inspected, cleaned, and regulated. If this service were inaugurated as an integral part of the gas company's business, there would be little need to fear competition.

A good part of my savings are invested in Gas Stocks and I am not proposing to sell out, but if I find a preponderance of men in the Industry holding Mr. Currier's views, it will necessitate second thoughts.

Bognor and District Gas and Electricity Company, Argyle Road, Bognor Regis.
Jan. 14, 1944.

Yours faithfully,
S. O. STEPHENSON,
Managing Director.

DEAR SIR,—I regret an omission in my letter to you which was published in your issue of Jan. 12, under the heading "Gas Boards."

In the fourth paragraph of my letter I stated: "It is understood that the Central Electricity Board has already planned all the plant replacements and extensions at every generating station in the country for four or five years ahead. The larger undertakings have programmed for some time ahead, but generally as separate undertakings and without co-ordination, which may result in unnecessary standby plant, &c." This should, of course, have read, "The larger gas undertakings have programmed for some time ahead."

Bradford Gas Department, Britannia House, Bradford.
Jan. 14, 1944.

Yours faithfully,
GEO. E. CURRIER,
Gas Engineer and Manager.

Diary

Jan. 22.—Manchester and District Junior Gas Association: Paper by C. Cooper, M.Sc. (W. C. Holmes & Company, Ltd.), on "Aids to Purification."
Jan. 31.—B.C.G.A. Domestic Heat Services Committee: Gas Industry House, 2.30 p.m.
Feb. 1.—B.C.G.A. Executive Committee: Gas Industry House, 12.30 p.m., preceded by a buffet luncheon at 12 noon.
Feb. 12.—Scottish Junior Gas Association: Joint meeting of Eastern and Western Districts, Edinburgh. Paper by H. B. Avery, Manchester Oxide Company, Ltd.

British Gas Federation

Sir David Milne-Watson, Bart., LL.D., D.L., has resigned the office of Chairman of the Council of the British Gas Federation, and the Council has elected Dr. E. V. Evans, O.B.E., F.I.C., to take his place.

At a recent meeting of the Council Sir David, referring to his resignation—he had filled the position since the formation of the B.G.F. nine years previously—said how much he had esteemed the honour of acting as Chairman and how much he had enjoyed the work, and thanked members for the ready assistance they had always given him. A new era was about to commence, and the National Gas Council and the British Commercial Gas Association would disappear as such and would be merged in the new British Gas Association. A short while ago he had been reading in the "GAS JOURNAL" a quotation of some of his words 25 years previously when he had asked for unity. If ever there was a time to reiterate an appeal for unity, it was the present. In an industry like the Gas Industry, covering the whole country, there was bound to be some criticism on most matters, and much could be learnt from criticism, but unity was essential, and it was most desirable that all should sink their differences and strive to lead the Industry in the way it should go. The Gas Industry had a great heritage and, despite what pessimists said, had done great things in the past, and he hoped all would work together to improve still further the Industry in the future. This could only be achieved by united effort. He concluded by thanking members warmly for all they had done for him, and for electing him as their Chairman for so many years. He could only hope that he would be able to attend meetings now and again in the future in an honorary capacity, as he would always maintain his interest in the work of the Industry.

Mr. Frank Jones, replying, said members would wish the Chairman to know how appreciative they were of the hard work he had done for them and for the Industry. He would like to have recorded on the Minutes the very great thanks of the British Gas Federation for the work of its one and only Chairman, and he proposed that a letter of thanks be sent to the Chairman expressing their appreciation and thanks.

Dr. Evans said he would like to support his Chairman (Mr. Frank Jones) in expressing to Sir David gratitude for all he had done for the Federation and for the Industry generally, and would like to say that members regarded him not only as their leader, but with very deep affection.

Sir David thanked members for their kind references to himself, and assured them that if ever he could be of assistance to them or the Industry, they could always rely on his help.

National Gas Council

A Meeting of the Central Executive Board of the National Gas Council was held on Jan. 11 at Gas Industry House. The Chair was taken by Mr. Frank H. Jones (Vice-Chairman).

Before proceedings commenced, the Chairman referred to the inclusion in the New Year's Honours' List of the names of Colonel H. C. Smith and Mr. Samuel Tagg as having received the C.B.E., and offered then the congratulations of the Board.

The death of Sir Russell Bencraft, Chairman of the Southampton Gaslight and Coke Company, was referred to with regret. In the year 1926–1927 he had been President of the British Commercial Gas Association, and had always been a very keen and loyal supporter of all the National Bodies. A letter of condolence had been sent to his Company, and the Council had been represented at the funeral service at Southampton.

It was stated that The Institution of Gas Engineers would be holding their Annual Meeting in Edinburgh in June this year, and that they had suggested that the June Meeting of the Central Executive

(*Continued on p. 90*)

POST-WAR COAL PROCESSING*

By G. M. GILL, M.Inst.C.E., M.I.Mech.E., M.Inst.Gas E., F.Inst.F.,
AND
JOHN ROBERTS, D.I.C., M.I.Min.E., F.G.S.

THE coal-mining industry is the parent of several others, and the power derived from coal was the foundation of the great industrial expansion which brought Great Britain into its foremost position as a world power. It is not intended in this Paper to dwell upon the historical aspects of industrial development in relation to our natural resource of power, but to draw attention to another aspect which not only has a direct bearing upon the coal industry itself, but which will also have a profound influence upon the welfare of the whole British community, and consequently of the Empire.

This parent coal industry normally produces its raw material for consumption in many directions at home and also for export abroad. Among the home consumers we have domestic users of coal, the Gas Industry and the electrical industry, as well as several other great industrial consumers. Thus the coal producers sell coal to their two main competitors, namely, the gas and electrical industries, and also to the coke oven industry, which latter is often owned by colliery companies, but is often independently owned. In addition, they compete with their own customers by supplying raw coal to the domestic consumer, so that processed fuel, coke and low-temperature fuel, made and marketed by independent companies, is in competition with the raw coal itself. If the raw fuel gave the same service to the community as the processed fuel, this competition might conceivably strangle the processing industries, especially while the parent industry is in a position to determine the prices which the processing industries, as well as the consumers of raw coal, shall pay for the coal. The fact that the processing industries have survived and expanded proves that raw coal itself does not meet present-day requirements of the community.

It is common knowledge that the best household coals are the "cream" of the coal-trade market, and if the coal producers are to encourage processing, they will do so at the expense of their trade in house coal. Naturally, they will not readily skim that cream unless they can be persuaded that it is in the best interests of the nation that they should do so.

It is fashionable to refer to the domestic coal trade as "the cream," but it should be remembered that the term is really most inappropriate. Cream is a most delectable portion of that body-building, energy-sustaining food called milk. This natural food when in an uncontaminated condition calls for no essential preparation. It can be consumed to the greatest advantage in its raw state as it leaves the cow. On the other hand, the coal normally used for household purposes is not a finished article of commerce. It is not in the condition from which the maximum energy can be recovered from it. On the contrary, the inevitable smoke produced by its combustion in the domestic hearth and in many industries is the source of great annoyance to the public, detrimental to their health, destructive to buildings and architecture, and so forth. In short, smoke is a noxious product derived from that class of coal which is most incorrectly described as "the cream."

Viewed from the profit-earning standpoint, however, if the coal producer vigorously encourages coal processing he would, at first sight, be sacrificing a profitable market. The solution proposed by some economists is a further basic alteration or re-orientation of prices. This would mean reducing the price of house-coal, and increasing the prices to the gas and electricity industries. One effect of the adoption of that proposal would be to increase the difficulties of the processing industries, because the cost of the processed fuels would increase as the prices of the house coals were reduced. Competition would therefore become more keenly felt in processing industries, thus hampering expansion.

The National Interest

Up to the present, the Gas Industry has been more or less able to stand up to the heavy increase in the price of coal, largely owing to the fact that an appreciable increase in demand has led to increased consumption per consumer. A further increase would result from a practical national campaign of smoke abatement which received the support of Parliament. This might conceivably enable the Gas Industry to pay more for its coal. If the production of smoke was made an offence in law, the Gas Industry would be prepared, and would in effect be compelled to pay the average cost of production for the coal it processed. Before seeking the support of the Legislature, however, we have to consider the question as to whether it is in the national interest to hamper expansion in the coal-processing industries. Are we to encourage the use of raw coal rather than that of its products? In which direction is the nation likely to benefit most? Should not our policy be "the greatest good for the greatest number"?

* From a Paper at a Joint Meeting of all the Chemical Societies and the Institute of Fuel, Bristol, Jan. 13.

Let us examine these questions from fundamental standpoints. In the first place, we must realize that smoky coal is a raw material. In its raw state it is not a finished product. It needs heat treatment. The only natural finished coal products are the smokeless coals, which include anthracite and those coals formerly classed as Admiralty smokeless steam coals. These smokeless coals form about one-tenth (more or less) of the potential output of British coal mines. Their occurrence is mainly confined to the South Wales coalfield.

That the proportion of such natural finished products (smokeless coals) is so small in relation to the quantity of raw smoky coal is really a tremendous advantage to this country, provided we turn our good fortune to account. The conversion of raw coal into finished articles of commerce offers scope for industry. That Nature has not finished her work of coal transformation is a fact of the greatest importance to mankind in general, because we are now able to make full use of the products stored up in the coal, which products would have been for ever lost had Nature completed the job for us.

In pre-war days one of us frequently used the "snowball argument" as related to labour in discussing the question of employment resulting from the extended use of home-produced coal. We can equally well apply this same argument to the products obtained from the coal. We will take the raw coal first.

In the discussion which follows, it must be remembered that wage rates and prices of products are not those prevailing in some districts at present. The argument, however, was sound in pre-war days, and will remain so in post-war years. For the purpose of illustration, we will assume that a domestic coal costs 17s. per ton at pit. This figure represents the cost of production, 16s. plus 1s. assumed profit. This coal is delivered into cellars at 51s. per ton. As the output of coal per man per day is one ton (we ignore the decimals), the getting of this ton finds employment for one man.

To transport that coal from pit to cellar involves a further expenditure of 51s.−17s.=34s. If the average profit in industry is between 5 and 10%, then it is safe to assume that about 90 or 95% of the cost of a product goes in paying for labour, so that the 34s. provides 16s. each for two men for one day, plus 1s. profit for each of two handling stages. Thus, the direct result is that three men find employment for one day for each ton of coal delivered into a domestic cellar.

These three men would otherwise have been unemployed, and drawing a dole (non-productive) which would be a very bare subsistence income. As soon as they become employed, however, each in turn becomes an "employer," inasmuch as he has money to spend, with which he engages others to make his boots, clothes, pots and pans, furniture, &c. His subsistence figure we will take at 8s. per day, thus leaving him (as he is now in employment) with 8s. extra to spend. This provides half the wage of another worker, so that three men "employ" one and a half men, and the latter another ½ man. To this ½ must be added ¼, and so on. Thus the "snowball" grows, with the result that one ton provides employment for six men.

We may next assume that one ton of coal represents 314 potential therms of heat. Dividing 314 by the cost of a ton of coal, the consumer buys 314÷51=6.1 therms for 1s. In other words, his coal costs him about 2d. per therm. Now, when we consider the price of gas or electricity on a therm basis, it might at first sight appear as if we are faced with a difficult snag. The two latter forms of potential heat are, in a sense, relatively dearer. We must admit that at once. Then arises the question as to whether the consumer must be made to pay more for his heat unit by using a processed fuel. We answer quite frankly that we are not so much concerned about the individual as the community. We have to take a wide view. It is not Bill Smith's interest in particular, but that of John Bull & Co., in general, with which we are concerned, and if John Bull & Co. reap the benefit, so will every Bill Smith. We shall show that far from being a snag the relative cost of therms becomes an advantage to the community.

Processing Provides Employment

We can now proceed to consider gas manufacture from the employment point of view. For our purpose we will assume that gas is sold at 10d. per therm, coke at 54s. per ton, tar at 3½d. per gallon, and crude benzole at 1s. 5d. per gallon.

	s.	d.
70 therms/ton at 10d. therm	= 58	4
½ ton of coke	= 27	0
10 gallons of tar	= 2	11
3 gallons of crude benzole	= 4	3
Total revenue from 1 ton	= 92	6

Again, taking the average profit as 5%, and assuming 95% goes in labour, 95% of 92s. 6d.=87.87s., cost of labour. Therefore, the direct employment resulting from the processing of one ton of coal =87.87÷16=5.49 men.

To this figure must be added the additional labour resulting from the increased spending power of the five and a half workers, making a total of eleven workers, calculating in progression as before. Therefore, we see that by using coal in the raw state, we find employment for a total of six men for one day for each ton of coal used and sold at 51s. per ton to the consumer. (To get the indirect figure, the direct employment figure must be doubled.) By treating the coal at a gas-works and selling the finished products—gas, coke, tar, and benzole—to consumers, we find employment for a total of 11 men for one day for each ton of coal carbonized. This latter figure represents an increase in employment amounting to 83%.

We are conscious of the fact that other authors or economists may approach this problem from other angles or base their calculations differently. Our figures are not hard-and-fast values, but are based upon reasonable assumptions for the purpose of illustration. Others may arrive at percentage figures higher or lower than the 83% figure previously given. We are prepared to meet them either way, as no pretence to academic mathematical accuracy is claimed for our figures. If it can be demonstrated that the figure should be 60% or 100% increase, the increase must necessarily be very considerable, and in any event the argument would lose little, if any, of its force.

As a warning to possible dissentients, we may remind them that the Gas Industry of Great Britain and Northern Ireland employs 125,000 persons and treats about 18,000,000 tons of coal per annum. Therefore, one person is employed for every 144 tons of coal treated per annum. In coal mining the output per man is 300 tons per annum. The ratio of employment in the two industries is therefore 300÷144 =2.08, or 108% direct increase in labour in coal processing. In other words the Gas Industry finds employment for two men in treating one ton of coal, while the mining of the coal finds employment for one man.

The extra employment is created by extracting the noxious smoke-yielding constituents from the coal. The smoke is waste and a nuisance, hence we recover wealth from waste, and at the same time help to create a clean atmosphere. The extra labour is wealth-producing labour, which we are out to create. In this process also we recover as a by-product, tar. This, although a by-product, becomes a "raw material" which forms the basis of other vast and important industries—namely, the coal-tar dye industry, the antiseptic industry, and (along with benzole) the plastics industry. Employment in the antiseptic industry is health-preserving as well as wealth-producing. It is a life-saving industry. The Gas Industry is being conducted with a high degree of process efficiency—upwards of 80% as compared with 20 to 30% efficiency when raw coal is burnt in grates or boilers.

Soot or Carbon Black?

An undesirable product produced by the imperfect combustion of smoky coal and tar is soot. Some millions of tons of this material are expelled into the atmosphere every year, where its presence proves to be most unwelcome. Here, again, the nuisance can be turned to account, as the carbon of soot is an ingredient which is essential in industry both in peace and war. In fact, soot has been deliberately manufactured from natural gas in foreign countries for a number of years, where the product of manufacture is known as carbon black, now so essential for reinforcement in the manufacture of rubber. At the present time this imported product also makes demands upon our restricted shipping space, which we can ill afford to spare. Yet at the same time one can see tons of this substance, irretrievably contaminated with ash and grit, belched forth day and night to foul the atmosphere in almost any industrial area.

What contribution can the Gas Industry make towards the solution of waste prevention in this direction? One answer to that question is the carbonization of the raw coal and the gasification of surplus tar and/or pitch, with the recovery of carbon black as a by-product. Pioneer work in this direction is being carried out on a large scale at three gas-works of the Severn Valley Gas Corporation group and by another gas company. A good deal of work has already been done, and although the results have not yet reached the 100% efficiency stage, sufficient is known to enable us to say that the Tar Gas Process, adapted for the treatment of pitch and tar by the late Leon B. Jones, former member of this Institute, will certainly be one solution of the problem of producing carbon black from home-produced coal. This departure definitely promises to be of outstanding importance.

Additional Coal to be Carbonized

The question of developing the carbonization industry may be viewed from various angles, depending on the interest or viewpoint of the observer. Considerations of health, comfort, the creation of productive employment, industrial and commercial efficiency, the recovery of by-products, defence services, &c., demand that the industry shall be expanded to its utmost limits. It is a matter of vital national importance. A further question that arises in this discussion is: How will it affect employment in other industries? Any attempt to forecast the answer to this question must be based partly upon facts and partly upon intelligent anticipation of events resulting from a close study of many aspects, and a proper appreciation of what can be accomplished both in technical and commercial directions.

It is well known in technical circles that carbonized fuel is more efficient than raw smoky coal; theoretically, 15 cwt. of first-rate smokeless fuel should "go as far" as one ton of coal, especially if the coke is free burning. At the same time, however, it must be remembered that increasing standards of comfort are being demanded by consumers, and it is not sufficient to produce a fuel which is effective only within a radius of 5 ft. or 6 ft. of the fireplace. The fuel must have a wider efficiency range, and this can be effected with first-class free-burning coke. The probability is, therefore, that advantage will be taken of this extended heating range, and consumers may appreciate this by using the same weight of smokeless fuel as of coal. This would demand that the cost of the fuel should not greatly exceed that of the best household coal; thus the consumer would receive greater value for the same outlay. Carbonizing processes which are to survive economic conditions are those that will enable production to be maintained on the above basis of price, which is well within the realm of practical achievement in the Gas Industry, in collaboration with its sister, the coke oven industry. We can assume that if we are to replace 35,000,000 tons of smoky domestic coal an equivalent quantity of smokeless fuel must be produced, solid and gaseous, and it is estimated this would involve the treatment of at least an additional 20,000,000 tons of coal.

A considerable advance towards the objective of a smokeless Britain could, however, be made by extending the existing large and efficient installations. This applies to gas-works and coke ovens, which could be extended by 50%.

In this connexion it should be noted that 161 gas-works, or 18% of all the gas-works in England and Wales, make 87% of all the gas. The capacities of these larger plants could well be increased on the average by 50%. Hand in hand with this expansion would be the establishment of a grid system extending over a considerable part of Britain. This would permit of the closing down of the small inefficient works, and the manufacture of cheaper and better gas. Thus the integration of the Gas Industry would be part of the coal-processing scheme which we visualize.

The two smokeless fuels with which we are mainly concerned in this discussion are gas and coke. It will not be sufficient for gas companies or coke oven companies to make only the one class of coke which now each produces, but they could and should also make free-burning open-grate coke. For preference, blended coking and non-coking coals should be used for the manufacture of open-grate coke. Thus three types of coke would be marketed—namely, (*a*) metallurgical coke from coke ovens, (*b*) ordinary gas coke, and (*c*) free-burning coke.

The Liquid-Fuel Aspect

The next question arising out of the adoption of such a scheme as that outlined is the effect on the liquid-fuel side. The benzole yield from the total quantity of coal to be carbonized annually would be about 200 million gallons per annum, or about equal to one-fifth of the quantity of petrol imported, which is about 1,000 million gallons per annum. In all probability it would not be more than sufficient to meet the annual increase in consumption of this light spirit. This product is also required for the plastics industry. If sufficient benzole or "coal petrol" for our whole requirements is to be obtained from coal, then the question of the extension of the hydrogenation process, by means of which the coal itself may be transformed into petrol, and the adoption of the synthetic process of Fischer-Tropsch, will have to be considered. This matter is outside the scope of the present discussion, as we are concerned with established commercial processes with which we are familiar, but it appears to be receiving attention elsewhere. The yield of tar from the additional 20 million tons of coal to be carbonized would be about 280 million gallons per annum additional to what is now being produced. From this we might reasonably expect to obtain one-third as much fuel-oil equivalent (pitch-creosote) as we now import direct of fuel-oil (crude petroleum is excluded). Therefore, from the carbonization side only, we can regard the oil yields as useful contributions to our fuel requirements, but complete independence of imported oil is not foreshadowed. Without in any way minimizing the importance of the liquid products, it must be again stressed that the development of the scheme depends mainly on the solid and gaseous fuel. The total tar produced could yield about 80,000 or 90,000 tons of phenols for the plastics industry.

Legislation Necessary

The task of replacing the whole of our domestic coal with smokeless gaseous and solid fuel is a formidable one, but technically there is no difficulty and therefore there should be no commercial difficulty. Perhaps the greatest obstacle to overcome is due to the conservatism of the masses and their rooted objection to change. It is here that the Government can be of assistance, by carrying through the necessary legislation at the proper time to encourage the use of smokeless fuels. The appropriate time for that will be when the producers have demonstrated that they can meet the demand without inflicting any hardship on the consumers, which means that the cost of fuel must be kept within reasonable limits. Any Bill introduced to that end should

prescribe a limit of 5, 7 or 10 years, as circumstances warrant, before any penalties could be inflicted on consumers of raw coal. At the moment all that is required is an indication that it would be the firm intention of the Legislature to pass suitable measures when the occasion arose.

In so far as the matter now under discussion deals with public affairs, and has a direct bearing on industry, employment, and national defence, it has to be admitted that it is a policital question. In fact, it is impossible to divorce fuel economics from political economy. Fuel utilization is a political question of the first importance in every fuel-producing country. Nevertheless, it is not a question of party politics, or of shirts or ties of any hue or colour. In handling a national problem, it is the nation which has to be served. This is essentially a national question.

FUTURE OF THE GAS INDUSTRY AND THE GAS ENGINEER

By Colonel C. M. CROFT, D.L., J.P., M.Inst.C.E., M.I.Mech.E.

Address to the Scottish Junior Gas Association (Western District)

[Abstract]

I DO not intend to deal with engineering problems of our Industry, but to deal entirely with the aspects of the profession which intimately concern all of us. These, of course, include such questions as engineering education and the prospects of the trained engineer, the qualifications needed for his success, and the preparation and training and also the future potentialities of such men. It should be realized that the work of the gas engineer is of prime national importance, dealing as he does with a large proportion of our diminishing, though greatest, national asset—coal—and seeing that it is used by the consumers economically and that the greatest service to the nation is ensured.

The question of remuneration and the position of men well equipped in training and also possessing personality and grit will be considered. It should be remembered that technical knowledge and skill in men and plant management are our stock in trade, and that the good opinion of your fellow men will, to a large extent, control future progress. All the qualifications needed by an engineer are incomplete without enthusiasm and imagination, for, by such do the dry bones of engineering become a living body.

I think it is desirable to realize that the engineer does not finish his training by learning his technical background and becoming a Chartered Engineer. The knowledge of mathematics, engineering, chemistry, physics, &c., is necessary to him as a foundation, and without that foundation he cannot start the first steps in the Industry. It must be realized, though, that many other qualifications are necessary to a greater or lesser degree for his personal "build-up," if he means to succeed. Therefore the greatest care should be taken in selecting the type of entrant to our profession. He is entering upon an exacting career. Gas and solid fuels must be supplied regularly throughout the year, and the greatest loads will generally come at the time of greatest strain on our men and our plant. Thus the Industry calls for good health and at times personal sacrifice. It also demands cool nerves and leadership of men.

An engineer, to progress from a junior position at a post of high responsibility, must be able to report clearly and concisely to his chief, and, as he advances in responsibility, to his board of directors or members of his gas committee. This requires a mind trained to clear thinking, coupled with the ability to make neat and accurate drawings.

Having obtained the right kind of lad, the next question is, What is the best way of training him? I think it will be agreed that he should have been soundly educated, and it is essential that he should have passed such an examination in elementary training as permits him to become a registered student in The Institution of Gas Engineers and/or in our other great Engineering Institutions. As you are all aware, the Institution is now drawing up a sound and practical scheme for the education and qualification of gas engineers, and while this is *sub judice* I will refrain from discussing the syllabus, but I will say emphatically that (*a*) no education from books, however imperative this is, will ever take the place of personal and practical experience. Both are essential. (*b*) A personality can and will be enriched, but never created, by the study of good books, whether technical or otherwise. (*c*) The training of a student can and must be helped by the encouragement, sympathy, and help of his seniors. This help can be best given by encouraging his stronger points and pointing out his weaker points. It should never be endeavoured to frame him on your own personality. Help him to develop his own in the best way. A student should not specialize too soon, but get as much and varied experience as possible, and be made to realize that the gas engineer must appreciate fully other branches of engineering and other professions which he will meet.

Before discussing the future prospects of the gas engineer it is necessary to try to foretell how our Industry will develop in the future. You will all have seen and read the Post-War Planning Report of the Gas Industry—an excellent document, encouraging, constructive, and written with considerable literary ability. Therefore we all know the shape of things to come as envisaged by our higher administration, but what we do not know is (*a*) when the war will end, and (*b*) the conditions under which we shall find ourselves at the end of hostilities. One thing is certain: out of all this disorder it is inevitable that a considered reorganization must come with the necessity for fuel economy and good service to the consumer. Economy will be pressed not only by Government action, but by inevitable and keen competition from the other available fuels, such as electricity, oil, and coal.

War not only demands sacrifice and wastefulness, but involves much research in engineering generally, and fuel consumption in particular. The result of this research—although it may not be apparent and generally available at the present—will be available after the war. Then will begin increased competition, and, in consequence, the need for greater efficiency in our Industry if it is to retain the position which its benefit to the nation deserves. Whatever steps are taken to gain these economies will require the greatest co-operation. We know ourselves that we have the processes, the skill, and the ability to withstand competition. We still have to realize that the public must appreciate our Industry to the full, and realize that we are ever improving not only technically but in our service to the consumer. This can only be gained by unremitting and efficient service.

The practical means of integration depend much on the geographical conditions existing. The problems of the small works far separated from his nearest undertaking are difficult, but many ways of help are available and every available facility must be utilized. Even if the smallest works, in isolated districts, were shut down as manufacturing stations, and bottled gas under high pressure was delivered into the holders, the gas supply would be improved, the standard would be maintained, the pressures would be controlled, and this would to a large extent assist the service to the consumer, which must be of a high standard nationally.

In the larger companies it is as essential for integration and united working as it is with the small ones. It may be interesting to some of my audience to hear that quite recently the Greater South London Gas Corporation has been created as a Private Company, the members consisting of the South Metropolitan, the Wandsworth, and the South Suburban Gas Companies. The existing Boards of these three Companies will remain unchanged in all respects, and their responsibility for the proper conduct of each Company is not affected. The Co-ordinating Board can in no way relieve any undertaking of its statutory responsibility. Each undertaking will retain its identity and individuality but, as far as possible, a common policy for the conduct of the undertakings will be recommended.

The duty of the Corporation will be to recommend to the Board of each constituent undertaking plans for development which shall be most beneficial to the three undertakings considered as one. This will be achieved by sharing the advantages possessed by one or other of the constituent undertakings, from the purchase of coal to the combustion of gas in the consumer's appliances and the working up and sale of by-products.

While it is not suggested that complete unification is in all cases possible, the policy adopted should be so controlled by co-ordination that the interests of (*a*) consumers, (*b*) the shareholders, and (*c*) the employees of all constituent undertakings are best served.

From these remarks it will be seen that much can be done to economize by inter-working without in any way upsetting statutory rights, the capital, or the internal management of the constituent companies.

From my previous remarks you will realize, I hope, that I have the greatest possible faith in the future and ever-increasing prosperity of our Industry; and a progressive industry performing service to the nation is one which should and must be controlled by men who receive adequate remuneration for their service, responsibilities, and ability. At the same time it must be realized that each undertaking has its different means of domestic organization, and that the management of private undertakings is generally different in a considerable number of ways from the administration of a municipally-owned undertaking. It should be remembered that while some gas engineers are, as their name implies, engineers in charge of designing and providing plant and making gas, others may have far more extended

duties such as the management to a certain extent of the offices, staff, &c., the sales policy of the company, the control of the district. In arriving at a salary which such men should be paid as a reward for their services, the nature of the individual service must be taken into consideration.

It seems that the best way to get as high a salary as man deserves is for him to show his utmost ability and keenness in the hope of reward. The good man is worthy of the most his undertaking can reasonably pay him, and the man of poor ability is expensive to his undertaking in any circumstances. It would seem that if there is to be any regulation of salaries, this can only be done by means of a scheme of "minimum salary" commensurate with the size of the undertaking and its sale of gas. The greatest drawback to this system is that many municipal authorities and boards of directors will consider this "minimum salary" as a "standard salary" from which it will be difficult to get increases.

I feel that both the Seniors and the Juniors are one team working together not only for improvement in their time but to leave the Industry greater for their work as they in turn hand over. Therefore, I consider it is necessary not only for the Juniors to know the trend of thought of the Seniors, but for the Seniors to have a full and uninterrupted view of the aspirations and ambitions of their successors. In fact, both the Juniors and the Seniors must work together each in their own sphere. Mutual appreciation and co-operation is essential, and I shall do all in my power to see that the Associations are kept in contact as much as possible with the Institution, and that they shall have the opportunity wherever and whenever expedient to express their views and seek the help of The Institution of Gas Engineers, whose sole anxiety is the maintenance of the high standard of personnel in the Industry to ensure that service to the nation is of the highest order.

DISCUSSION

Mr. **James Jamieson** (President of The Institution of Gas Engineers) said he believed that there were few if any more interesting and useful careers than the Gas Industry could provide for men who were able and willing to educate themselves to the standard necessary for the technical, executive, and administrative posts which were becoming available in steadily increasing numbers. Anyone who kept in close touch with the Industry through the Technical Press and the publications and reports of the various gas organizations must be impressed by the increasing complexity of the Industry in all its aspects, and as a direct consequence of that increasing complexity, by the expanding prospects of future growth and development. They must be impressed, too, by the number of problems which awaited solution, problems which when solved would open still wider prospects. These problems were both technical and administrative, and many would have to have applied to them all the brains and experience that the Industry could muster among its educated personnel. And the number of educated personnel was all too small for the task which confronted them. Hence the need for promoting a higher standard of education among existing staffs and of attracting to the Industry still more people with the proper training and qualifications.

And when they talked of education, they did not mean only technical knowledge, however necessary that might be, but rather that mental outlook which came from a wide practical experience both of technical problems and of men and affairs. The truly educated mind had the interested and enquiring mind, which sought knowledge because it wanted to know, and not just because it wanted to pass examinations. Where interest and enthusiasm lay, the passing of examinations was merely incidental. The need for the wider outlook was implicit in the size and national character of their Industry.

The needs of the Industry were therefore threefold. First, they must have technically educated personnel, who would be constantly seeking better methods of processing the nation's coal to the greatest advantage and of using the products in the best interests of their 12 million consumers. Secondly, they must have administrators who were capable of discharging the social responsibilities of the Industry to all those who depended upon it for a livelihood. They must keep the Industry prosperous and maintain harmony between employers and employed. Thirdly, they must have the negotiators who would, during the process of reorganization of the Industry, be able to reconcile conflicting interests, preserve harmony, and encourage co-operation.

The outlook of management in the Gas Industry must embrace more than the control of a particular undertaking. It must appreciate the trends not only in technical research and in public demand, but in the developments of modern business and commerce. A national fuel policy which would contribute so much to the prosperity of both the carbonizing industry and of the nation would undoubtedly be easier of attainment if they had the men in the Industry who would recognize the need for co-operation not only within the Industry but with the Government departments, and even with those industries which were now regarded as our competitors.

It was a complicated Industry, becoming even more complicated, and its clamant need was for more and more specialists—specialists in technical research on production, in utilization, specialists in market research and selling, and, above all, specialists in management—men of education, experience, and broad outlook. Given such men there was no fear that the Industry would fail to provide them with the remuneration to reward their zeal.

(*To be continued*)

OXIDE PURIFICATION*

By B. McLEISH, A.M.T.C., A.A.C.I.,

Metropolitan Gas Company, Melbourne

(*Continued from p. 61*)

Activation of Natural Iron Oxide

As the cubic to rhombohedral transition is irreversible, physical alterations will not increase the total absorption of oxide above the theoretical figure for the reactive ferric oxide present, but it may be done chemically by dissolving the inert ferric oxide in caustic soda and then precipitating it as ferric hydrate—that is, reconverting to the reactive cubic form. This has been accomplished, and the reactivity of such a hydrate establishes it as an impure α ferric hydrate with a smaller percentage of the amorphous, together with impurities from the original Port Macquarie oxide (see graph No. 13). The procedure was to take a portion of unreactive oxide (heated previously to 1000°C.), and add to it an excess of 80% caustic soda solution. The mixture was kept at boiling point for several hours, during which time a considerable amount of oxide went into solution. The whole was cooled, diluted, and ferric hydrate was precipitated. Owing to the difficulty of removing unreacted material by filtration of 80% caustic soda under large scale conditions, the resultant hydrate was allowed to retain the original impurities peculiar to the natural oxide. Actually the ferric oxide was converted to sodium ferrite, which on dilution to about 30% strength was hydrolysed to ferric hydrate and caustic soda.

$$Fe_2O_3 + 2NaOH \longrightarrow Na_2Fe_2O_4 + H_2O.$$
$$Na_2Fe_2O_4 + 2H_2O \longrightarrow Fe_2O_3.H_2O + 2NaOH.$$

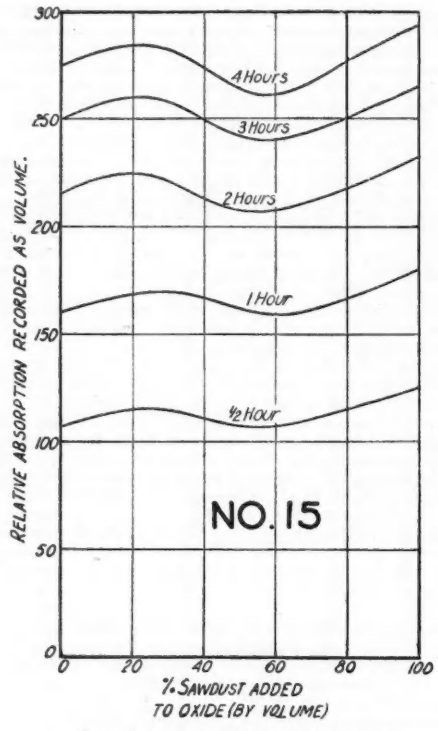
A second sample of oxide, this time "spent" oxide containing 40% sulphur, was heated on a Meker burner until all sulphur was expelled. The residue was then heated to 950°C. for one hour with 1½ times its weight of sodium carbonate. The mass on cooling was treated with water and the sodium ferrite previously formed hydrolysed. The residual hydrate was then tested for hydrogen sulphide absorption. It showed a reactivity in excess of the original Port Macquarie oxide while the total absorption was likewise higher. The reactivity, shown in graph No. 14, indicated the original amorphous form. Evidently the amount of active hydrate had been increased by the partial removal of non-ferric impurities, and also by the conversion of some of the inert ferric oxide into the reactive form.

The graphs show clearly the crystalline nature of the hydrate formed by the first method. The total absorption indicates that approximately 50% of the oxide is present in the reactive form, so the reactivity is shown compared with a 50% α hydrate with 7% free water. The influence of a small amount of amorphous hydrate would convert the 50% α graph into one very similar indeed to that of the "activated" oxide. The "soda carbonate roasted oxide" shows a total absorption representing over 70% of reactive hydrate, but there is still a mid-graph depression in comparison with a 70% amorphous graph. Note also that the initial velocity is practically the same as that of the normal oxide, yet the total absorption is about 30% higher. This suggests the removal of, or rather the non-reformation of, the small percentage of α hydrate originally present in the unheated oxide. It is not suggested that these methods should be applied in order to reactivate the oxide, unless the process is more or less one for the absorption of residuals as is the case with "Luxmasse"—the German synthetic oxide. This material is a mixture of α and γ hydrates, totalling about 50% of the whole mass. Bauxite containing a relatively high iron percentage after treatment for aluminium has crystalline ferric oxide in a non-reactive form (probably the rhombohedral form, rendered more inert by high temperature). On roasting the mass with sodium carbonate and treating in a manner similar to the sodium carbonate method previously described, a highly reactive purifying material is obtained.

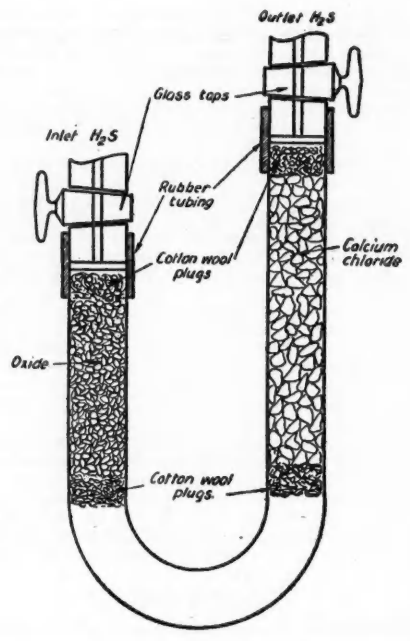
Porosity in Oxide Boxes

The possibility of keeping an oxide during fouling comparatively free from back-pressure is obviously dependent on the physical structure of the oxide. For a porous mass with high hydrogen sulphide absorption the apparent granulation of the material must be fairly large, but each coarse granule should itself be composed of exceedingly fine

* Technical Research Report No. 2 of the National Gas Association of Australia.



Effect of Sawdust addition to Reactivity.



NO. 16

Apparatus used in Mortlake Method of Recovery.

particles loosely packed so that a very large surface area is available. Port Macquarie's oxide has a reasonable degree of fineness, but with free water it very quickly cakes to a tight mass of low porosity. The addition of a fine light powdered bauxite with a high water absorption reduced the reactivity of the oxide, due to clogging or coating the reactive hydrate. A coarser material such as sawdust helped to keep the mass loose and actually increased the reactivity, although a large percentage by volume was necessary.

If the idea of removing free sulphur from spent oxide possibly by heat treatment is kept in mind, the use of sawdust loses much of its appeal. A porous inorganic material, unaffected by a temperature of 450°C., reasonably light, and inexpensive is required. A refractory insulating brick was broken up, and by sieving, a granulation of ⅛ in. was obtained. The addition of 20% of this material to Port Macquarie oxide practically overcame the caking tendency. The possibility that soluble acid salts might cement the particles of oxide together was considered, but it was found that no appreciable difference in pH or soluble salt content was apparent with either caked or loose oxide taken from the same box after fouling.

The use of mechanical breakers and the costly handling would be reduced to a minimum by the addition of some material as suggested above, whilst the period of activity in the boxes would be increased owing to prevention of back-pressure. Revivification would be much more effective, as the continued porosity would allow a freer passage of humid air, as well as tending to prevent local rises in temperature above 50°C. with sulphate formation. The effect of sawdust addition on reactivity is shown in graph No. 15.

A treatment whereby sulphur can be removed at a temperature below 450°C. would allow the oxide to be used over and over again. Care in keeping the pH in the region of 6 to 8, a controlled temperature of 29½°C. to 32°C. (85° to 90°F.), a free moisture content of 6 to 7%, the use of a suitable material capable of keeping the oxide loose; a humid atmosphere and the prevention of even local temperature above 50°C. during revivification; the possible washing or partial washing of the oxide in order to remove soluble salts, and the selection of an oxide of total hydrogen sulphide absorption of over 30% by weight, would allow hydrogen sulphide purification of coal gas to proceed indefinitely with practically no replacement with fresh oxide.

The alternative is to prepare a pure *α* hydrate, and add to it sufficient material which would be capable of keeping the mass porous and which would be unaffected by free sulphur removal under 450°C. It must be remembered that while the initial cost of preparing such a hydrate would be comparatively high, the quantity for replacement would be practically negligible. The activity of this oxide being so much greater than that of the natural oxide would mean that less oxide would be necessary for purification, although the removal of free sulphur from the spent oxide would necessarily have to be repeated more often. Again, it must be realized that a pure *α* hydrate could be kept porous by almost its own weight of suitable inert material, and yet have a total absorption equal to Port Macquarie oxide and a reactivity very much greater.

The removal of free sulphur by the usual roasting method renders the oxide incapable of being reactivated economically, and so the possibility of low temperature sulphur removal should be fully considered. As the absorption of hydrogen sulphide is dependent fundamentally on ferric oxide, reduced pressure and temperatures below 400°C. should be sufficient to remove sulphur, and yet not affect the activity of the oxide, even though it may lose a considerable percentage of water of hydration. The removal of sulphur by solution appears too costly, and the difficulty of filtration of fine sulphur is another obstacle. War conditions further emphasize the need for additional experimental work on this suggested form of sulphur removal, firstly to conserve oxide stocks, and secondly to make available for Australia a large tonnage of sulphur—a commodity which will become more valuable as importation becomes more difficult.

Conclusions

1. In natural iron oxide from Port Macquarie the active portion for hydrogen sulphide absorption is the hydrated oxide, which comprises approximately 50% by weight of the total oxide. It is considered that the bulk of the active portion consists of the amorphous ferric hydrate.

2. The optimum conditions for hydrogen sulphide absorption by Port Macquarie oxide are 6.5 to 7% moisture and 29–32°C. (85–90°F.).

3. Acidity in the purifiers lessens the activity of Port Macquarie oxide. The optimum hydrogen ion concentration has not been accurately determined but is within the range of 6 to 8.

4. By heating Port Macquarie oxide above 500°C., no stable hydrate is reformed when the oxide so treated is brought into contact with water, and the reactivity of the oxide is substantially reduced.

5. On heating Port Macquarie oxide through a temperature range of 500°C. to 700°C., an irreversible change occurs from the active cubic to the inactive rhombohedral crystal form, with a corresponding loss in activity for hydrogen sulphide absorption.

6. By methods described, it has been found possible to convert chemically the inactive rhombohedral form of oxide into the active cubic form.

7. It has been shown that the chemically converted oxide has a greater activity for hydrogen sulphide absorption than has the original Port Macquarie oxide.

8. An inert filler of nature of granulated refractory insulating brick was found to give the desired porosity to minimize back-pressure without development of caking in service or decomposition during roasting.

9. The use of ferric hydrate chemically prepared from natural iron oxide is considered to have definite technical advantages for works conditions. The economics of its use have not been investigated.

10. The need for further experimental work on the removal of sulphur from spent oxide by low temperature thermal treatment is indicated.

FURNACE DESIGN*

By L. MUIR WILSON, South Metropolitan Gas Company

I CANNOT tell you what heat is because I do not know. But I can explain some of its effects. We must consider its ways before coming to furnace design. A furnace is a vessel where chemical reactions go on at high temperatures. The principal reactions usually take place between inflammable gases and air, but chemical changes in the charge may be brought about, while it is always the object to cause some physical change to the charge. This may be only the conversion of water into steam or the softening of iron for forging purposes. I will not deal with furnaces which burn solid fuels directly, though in these the major portion of the combustion may take place in the gaseous phase. Nor will I say anything about electric furnaces. Some furnaces are fired with liquid fuel or powdered fuel, and these behave very much as gas-fired furnaces. I should mention in passing that blast furnaces have the prime object of bringing about chemical change for they reduce iron oxide to iron, but it is necessary that the iron and slag should be produced in a liquid state. In them the main reactions are thought to take place between solids, but gas reactions play an important part.

Before going away from blast furnaces I would like to suggest that they do seem to be the best means of producing low grade gas for heating when it is wanted in large quantities, and the quantities that a blast furnace can make are truly large. A blast furnace making the not abnormal quantity of 5,000 tons of iron a week produces about 5 million cu.ft. of gas per hour. Not only is clean blast furnace gas the finest gas for heating carbonizing plant; while producing the gas we are doing something useful by making iron rather than just burning coke as we do in a producer. The special attraction of blast furnace gas comes about because it is almost free from hydrogen, which has to be a principal constituent of producer gas if it is to be made with reasonable cold gas efficiency. Its nitrogen content is lower than in producer gas; this leaves plenty of room for carbon monoxide, which radiates its heat most readily. Thus a very gentle even heating medium is available. Seeing that blast furnace gas is made by blowing air through coke, the question arises why it should have an oxygen nitrogen ratio higher than that of the atmosphere, but this is immediately explained when we remember that the main function of the furnace is to remove oxygen from iron ore.

Furnace designers use any amount of empirical formulae. From them we can get an approximation of the furnace volume required to burn a given quantity of gas in unit time, of the tons of regenerator filling required to recover the waste heat when burning a given quantity of fuel per hour, there are tables of heat transference drawn up, and so on *ad infinitum*. Much of this information is useful, but it is impossible to make the best use of it or apply it intelligently without understanding how profoundly it can be affected by conditions. For instance, the rate of combustion may be very much speeded up if the reagents are rendered turbulent, and the weight of regenerator filling may be very much economized by proper design, which increases the effective surface considerably. Much of this empirical information is based on good practical experience, but so long as we regard it as axiomatic and close our minds to its possible limitations, it will be a great hindrance to further progress.

Flames

Flames need defining, and this is very difficult because there are so many different types. But a flame to me is something alive, not necessarily sparkling and brilliant, but essentially different to a stream of hot waste gas even if that stream be at the same temperature as that calculated for a flame with which it is compared. To me a flame may have no real temperature, for temperature I associate with energy after it has been absorbed by some material. The energy released in a flame by the breaking down and association of molecules is more to be likened to sunshine. Momentarily the energy is free and nascent; not yet has it been absorbed by the products to form hot waste gas. It is free to slip away as radiation, or to penetrate into the walls of the furnace or into the material which is being heated should the furnace be of the open hearth type. This outlook of mine may be far from scientific, but the fact remains that a real live flame will do far more effective work than the same quantity of waste gas, which presumably contains the same amount of thermal energy. A flame is essentially chemical by nature, waste gas is essentially physical; perhaps this makes it different and less romantic.

Flames may have many different patterns. But I am inclined to say that a flame is a volume in which chemical reaction between gases takes place. Usually it may be easily visible in contrast with its background, for it emits both light and heat. Sometimes when close to a highly heated environment it is difficult to identity with the eye. Under certain circumstances, when refractories are in intimate contact with explosive mixtures of gas and air, they glow with the emission of little or no apparent flame. This phenomenon is called surface combustion. To initiate the reaction it is usually necessary to apply a light to ignite the mixture, and the effect described only develops characteristically when the refractory has become thoroughly heated. Platinum, however, when suitably prepared will glow up all of itself when in contact with explosive mixtures of gas and air, and may continue to produce a state of apparently flameless combustion so long as it is in contact with an explosive mixture. This so-called flameless combustion is much more easily maintained with the gas hydrogen than with any other gas. It is probable that in all high temperature furnaces the linings play an important part in encouraging combustion by promoting these surface effects.

When combustible gas, free of oxygen, issues into the atmosphere, the flame produced draws its air supply from the air it entrains as it travels along. Thus, the flame produced is really a hollow envelope of inflammation full of gas, for combustion can only take place where the oxygen and combustible gas are in contact.

When ready-made explosive mixtures of gas and air are burned as they issue from orifices, the resulting flame is of smaller dimensions than the envelope flame produced by the combustion of gas at a corresponding rate. Because, due to intimate mixing, the air and gas are in contact, with the result that a continuous explosion is maintained. Flames of this type are not just skin effects but are in a state of inflammation throughout. They can be produced under water and in inert atmospheres. As the amount of air in the mixture is reduced from that required to give complete combustion, the gas has to draw on the surrounding air, if any is available, for its oxygen supply. Thus, as the primary air supply is gradually reduced, the flame becomes first of all an approximation between the fully aerated and the envelope flame, finally finishing up as a flame of the envelope type.

Flames such as I have described have many modifications; in fact all three types of combustion (surface combustion, combustion proceeding as oxygen becomes available, and the continuous explosion) may take place simultaneously in a furnace.

When mixtures of inflammable gas and oxygen or gas and air are made up and then ignited, they will explode should the mixtures be within certain limits centering about the mixture which gives complete combustion of the reagents. As an instance let us have a mixture containing two molecules of hydrogen to every one of oxygen and place it in a one litre spherical bomb. On ignition we can liken the interior to a dance hall floor where boys and girls are in a state of rapid motion seeking partners. A boy will at first stand a very good chance of bumping into a girl, but he may bump into another boy. If he does not bump into a girl fairly soon he will begin to bump into united couples too, and even when the dance is over, there may still be a few forlorn specimens of each sex looking for partners. This illustrates how flames flare up quickly and then die away slowly. It is more usual for explosive mixtures to be made up of gas and air, which contains nitrogen. This is like introducing on to the dance floor four stout chaperones for each dancing girl, with the result that the pairing process will be ever more protracted. Thus when the explosion takes place in the bomb the pressure rises rather slowly just at the start; this slowness is due to the fact that the reaction goes more quickly as the temperature rise gets under way. Very soon, however, it reaches a maximum, and then gradually fades away as it becomes more difficult to find unreacted molecules. It is usual to record these pressure changes on a rapidly moving film across which the pressure gauge pen moves at right angles.

If an explosive mixture of gas and air is permitted to escape upwards through an orifice, a continuous explosion results on ignition.

At first combustion is rather slow; then the sideways expanding force analogous to the movement of the pen arm reaches a maximum, and finally the flame fades away and becomes extinguished before combustion is quite complete. Under conditions of very high temperature the gradual fading away of the flame may be extended by circumstances in addition to those which can be explained kinetically, for some cooling must take place before the exothermic reaction can go towards completion. The upward thrust from gravity, of course, corresponds to the movement of the film. Should there be an excess of one of the reagents in the flame it will have a slowing down effect similar to that of an inert gas but not so marked. For instance, an excess of oxygen particles will hinder other oxygen particles in going about their business but will be of no hindrance to hydrogen particles, whilst nitrogen particles are a hindrance to neither.

A flame of the type just described is unusual, for it is seldom that we see flames burning in anything but an atmosphere of air. And, of course, the excess air gets entrained in the flame and modifies it. When an inflammable gas is permitted to escape out into the atmosphere and burn, it entrains the air required for combustion as it goes. Thus, if the pressure of the atmosphere is reduced, the flame tends to get longer because it has to travel farther amongst the more widely spaced molecules before it can pick sufficient of them for complete combustion. The length of the flame is primarily governed by the distance it has to go in search of oxygen molecules. Thus, under these conditions, and although hydrogen is capable of burning much faster than carbon monoxide, the resultant flames, both of which

* From a Paper to the London and Southern District Junior Gas Association.

require the same amount of oxygen, are of about the same length provided stream-lined flow is provided at the orifice.

In the case of ready-made mixtures the faster and lighter hydrogen gives a much shorter flame than will carbon monoxide, though both have about the same calorific value and need the same volume of air for combustion. The curious thing about carbon monoxide is that it radiates more heat than hydrogen. It almost seems that the more nimble hydrogen is able to snatch the liberated heat for the purpose of its self-propulsion, while the carbon monoxide lets it slip away. In these two types of flame there are other differences. The ready-made mixture flame is flame throughout. The other flame is just a hollow envelope, only the surface of which is burning. This envelope is, however, at an exceedingly high temperature as compared with the temperatures obtainable in the ready-made mixture flame. This possibly may go some way toward explaining its luminosity. The most important difference is, however, that the length and therefore the intensity of the ready-made mixture flame is controlled by the nature of the inflammable gas, whereas the length of the other flame is governed by the rate at which the combustible gas can become mixed with oxygen.

(*To be continued*)

NATIONAL GAS COUNCIL—continued.

Board might also be held in Edinburgh during that period. It was agreed to make enquiries as to whether the proposal would be practicable.

A report on the general coal position was received.

Dr. E. V. Evans, Chairman of the Committee, made a report to the Board on the questions discussed at the last meeting of the Gas Advisory Committee, which included the following matters: (*a*) Labour; (*b*) calorific value; (*c*) war damage and bombed property; (*d*) use of gas producer plant; (*e*) C.W.G. plant.

Town and Country Planning (*Interim Development*) *Act*, 1943—*Draft General Interim Development Order*.—It was reported that the Council had submitted representations in the first instance to the Ministry of Fuel and Power, contending that the draft Order was *ultra vires* on the ground that it was anomalous that the Minister of Town and Country Planning should be empowered to exercise more stringent control under an Interim Development Order than he would be authorized to exercise under a final Town and Country Planning Scheme.

It was stated that the annual meeting of the Conference of Public Utility Associations had been fixed for Jan. 26. It was also stated that the Chairmanship of the Council fell to the Gas Industry this year, and that the Chairman would be nominated by the gas representatives at a meeting to be held prior to the annual meeting.

It was stated that the next meeting of the Board would be held on Feb. 8, at 2 p.m.

Institution of Gas Engineers

The last two meetings of the Council of The Institution of Gas Engineers were held in London on Dec. 14, 1943, and Jan. 11. The following are some of the matters dealt with at the two meetings.

The award was reported of Honours to members of The Institution of Gas Engineers and of the Gas Research Board, as already recorded in the "JOURNAL."

It was decided to invite the Affiliated District Gas Associations and the Junior Gas Associations to submit Papers, as usual, for the award of the Institution Silver Medal, 1943, and the Institution Bronze Medal, 1943, respectively.

On the invitation of the President (Mr. James Jamieson), it was decided that, circumstances permitting, arrangements should be made to hold the 81st Annual General Meeting in Edinburgh in June.

A report was made of the work of the following Technical Committees of the Institution: (*a*) Meters Committee; (*b*) Liquor Effluents and Ammonia Committee; (*c*) Gas Installations Committee, the final Report of which was submitted to the Ministry of Works on Dec. 7, 1943; (*d*) Codes of Practice Sub-Committee.

A report was made of the fifth meeting of the Co-ordinating Committee of the Gas Engineering Advisory Boards, attended by the Director of the Gas and Electricity Division of the Ministry of Fuel and Power and members of his staff, held on Oct. 29, 1943.

It was reported that the Post-War Planning Committee, having completed the work allotted to it under its Terms of Reference, the Council of the British Gas Federation had approved the appointment of a new Committee to deal with the reconstruction and reorganization work arising from the Report on the Planning of the Gas Industry. Three representatives of the Institution were nominated to serve on this Committee.

Consideration was given to the appropriate action to be taken by the Institution to encourage the entry into the gas engineering profession of an increased number of suitably qualified young men, and it was decided to set up a Careers Sub-Committee to deal with the matter.

It was reported that the Senate of Leeds University had awarded the Institution Gas Research Fellowship to Mr. R. E. Jones, B.Sc., for one year in the first instance, as from Sept. 1, 1943. The Fellowship had been relinquished on July 31, 1943, after two years' tenure, by Dr. J. E. Garside, on his appointment as Assistant Lecturer in Fuel Technology at Leeds University.

[Ewart.

Letchworth is to perpetuate the memory of Stalingrad, the great city of Soviet Russia. To-day there hangs in the works of Messrs. Ewart & Son, Ltd., a replica of the Stalingrad sword, which the employees in the tool room have made out of scrap metal during their off-duty hours. Weeks ago the firm and employees were invited to contribute £150 for the endowment of a bed in the proposed new Stalingrad Hospital. Enthusiasm on the part of the directorate and employees has been such that no less than £300 has been raised—enough to endow two beds—and a cheque for this amount was presented by Mr. A. M. Evetts, the General Manager, to the Rev. F. Thatcher, Rector of Letchworth, in aid of the Stalingrad Hospital Fund.

The *Ironmonger Diary and Hardware Buyers' Guide* is 76 years old, and the 1944 edition just out is well up to the standard of its predecessors. The literary section, which in these days of constant change has to be completely revised each year, gives a remarkably complete though concise account of the legislative restrictions which wartime conditions have imposed upon the freedom of the ironmongery and hardware trade. There are summaries of innumerable controls, limitations, orders, priorities, prohibitions, restrictions, &c., which would appear to leave little scope for any retail business whatever. Many normal wares cannot now be made at all, others are produced in limited quantities, and most are subject to price control, so that the retailer's lot is not altogether a happy one. The advertisement and buyers' guide sections of the *Diary*, however, strike a very much more cheerful note. If there is no rash optimism about an early end of the war, there is at least an atmosphere of confidence running through the whole book, which leaves no doubt that the trade will be well prepared for the new conditions which will arise immediately after the end of hostilities.

The 1944 edition of the *Mechanical World Year Book* (Emmott & Company, Ltd., 78, Palatine Road, Manchester, 632 pp., 2s. 6d.) has been extensively revised to keep abreast of progress in engineering knowledge, and contains a well-selected range of technical information, handy tables, and a very healthy array of advertising matter. It is pointed out that development of our wartime economy has brought to engineering more detailed knowledge of the newer materials and a wider conception of the uses and relative capabilities of engineering materials generally, the number of which formerly tended to increase without strict regard to utility. Workshop and factory processes have been subject to similar refining influences, so that altogether the effect of the war upon industry has been the elevation of technique to new and higher standards. The flexibility required of industry in recent years will have to continue as an essential property under almost any conceivable future conditions. While success depends much upon individual initiative and ingenuity, there are guiding ideas based on present-day data and information, such as are collected in a condensed and readily available form in the *Year Book*, and the publishers gratefully acknowledge the help received in the way of suggestions from readers of earlier issues.

The fact that goods made of raw materials in short supply owing to war conditions are advertised in the "Journal" should not be taken as an indication that they are necessarily available for export.

THE Radiation Gas and Solid fuel kitchen, which has been on exhibition at Radiation House for several months, is now well known to the Gas Industry as the first practical example of post-war planning, using materials then expected to be available.

Wide publicity was accorded to the design by the Public, Professional and Trade press, a selection of which is given below.

THE ARCHITECT & BUILDING NEWS
ARCHITECTS' JOURNAL
ARCHITECTURAL DESIGN & CONSTRUCTION
ARCHITECTURAL REVIEW
BATH & WILTS CHRONICLE
BIRMINGHAM GAZETTE
BIRMINGHAM POST
THE BUILDER
BUILDERS' MERCHANTS' JOURNAL
BUILDING INDUSTRIES
COKE & SMOKELESS FUEL AGE
COLLIERY ENGINEERING
DAILY MIRROR
GAS JOURNAL
GAS TIMES
GAS WORLD
GOOD HOUSEKEEPING
HEATING & VENTILATING ENGINEER
HOMES & GARDENS
IDEAL HOME
ILLUSTRATED CARPENTER & BUILDER
THE IRONMONGER
LOCAL GOVERNMENT CHRONICLE
MODERN WOMAN
MUNICIPAL JOURNAL & LOCAL GOVERNMENT ADMINISTRATOR
NATIONAL BUILDER
OFFICIAL ARCHITECT
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GAS PRODUCTS PRICES—STOCKS AND SHARES

The London Market Jan. 17.

All Coal Tar Products are in good demand, and Pitch in the London area remains about 45s.

The new Coal Tar Products Prices Order, 1943 (S. R. & O. 1528), came into force on Nov. 15, fixing the prices at which Coal Tar Oils may be sold for various specified purposes. It also confirms the prices which may be charged for other Coal Tar Products under earlier Orders.

An Order entitled The Control of Toluene (No. 3) Order, 1943 (S. R. & O. 1943, No. 976), came into force on July 20, and introduced certain changes in the prices for different grades of Toluene.

There is nothing to report with regard to prices of Coal Tar Products, which are unchanged.

The Provinces Jan. 17.

The average prices of gas-works products during the week were: Pitch and Crude Tar,* Toluole, naked, North, 90's, 1s. 11d. to 2s. 1d., pure, 2s. 7½d. (controlled by the Control of Toluene No. 3 Order, dated July 14, 1943, operative from July 20, 1943). Naphtha and Xylole controlled by the Coal Tar Naphtha and Xylole Order, 1943, dated May 31 (S. R. & O., 1943, No. 768), operative from June 1. Carbolic acid, 60's, naphthalene, anthracene, creosote oil (hydrogenation), coal tar oils (timber preservation, &c.), and strained anthracene oil controlled by the Coal Tar Products Prices Order, 1943, dated Oct. 20, 1943 (S. R. & O. 1943, No. 1528), operative from Nov. 15, 1943.

* In regard to pitch and crude tar prices we would ask readers to refer to the editorial note on p. 396 of the "JOURNAL" for Sept. 10, 1941.

Scotland Jan. 15.

Export enquiries are numerous, but home requirements take precedence. Refined tar*: Yield to Distillers is 4½d. per gallon *ex* Works, naked. Creosote oil: Timber preserving quality,* 5½d. to 6½d.; hydrogenation oil,* 5⅞d.; low gravity or virgin oil,† 7¼d. to 7½d.; benzol absorbing oil,* 6½d. to 8d. per gallon. Refined cresylic acid* is 3s. 6d. to 4s. 6d. per gallon *ex* Works, naked, according to quality. Crude naphtha†: 6½d. to 7d. per gallon. Solvent naphtha*: Basic prices delivered in bulk, 90/160 grade, 2s. 8d., and 90/190 Heavy naphtha, Unrectified, 1s. 10½d.; Rectified, 2s. 3d. per gallon. Pyridine†: 90/160 grade, 13s., and 90/140 grade, 15s. per gallon.

* Price controlled. † Uncontrolled.

Markets were dull at the opening, but as the week progressed a firmer tone was set up, especially in the gilt-edged, industrial, and home railway sections. On the week as a whole there were 2,378 more markings at 28,287.

There was also more activity in the Gas Market, and all prices were maintained with a few showing improvement in value. In anticipation possibly of some increase in the ordinary dividend disbursement Gas Light units closed 9d. higher at 20s. 3d. and South Metropolitan also improved. Dividend announcements will shortly be appearing, and whilst it is probable that the majority of the provincial companies will maintain their usual rates, it will be interesting to see how the holders of stock in the three Metropolitan companies will fare for 1943.

The following prices were changed during the week:

PROVINCIAL EXCHANGES

Liverpool 4 p.c. Deb....	101½—103½	+2½
Sheffield 4 p.c. Deb. (*x.d.*)	98—100	Jan. 3
Weston-Super-Mare 4 p.c. Deb. (*x.d.*)	99—101	,,
Ditto 7½ p.c. Deb. (*x.d.*)	142—147	,,

OFFICIAL LIST

Gas Light Units	19/9—20/9	+-/9d.
Ditto 3½ p.c. max.	78—81	+2
Ditto 3½ p.c. Red. Pref.	96—99	+1
Ditto 3 p.c. Deb.	82—85	+1
South Metropolitan Ord.	87—90	+1
United Kingdom Gas Corporation Ord.	20/9—21/9	+-/3d.
Wandsworth 4 p.c. Pref.	93—98	+1

SUPPLEMENTARY LIST

Plymouth & Stonehouse 5 p.c. Deb.	114—119	+2
Slough 5 p.c. Deb.	115—120	+1
Uxbridge 5 p.c. Deb....	115—120	+1

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